Demography India
Vol. 24, No. 1 (1995), pp. 33-58

Aswini Kumar Nanda* and Samidha Khurana**

From Hearth to Earth: Use of Natural Resources for Cooking in Indian Households[t]

Introduction

ONE of the indispensable ingredient of rural development agenda in India has been the fulfilment of the energy gap and modernization of energy sector. Being crucial for decent living, easy availability and efficient utilisation of energy by the masses is often regarded as pre-condition for any effort of economic and social development to be undertaken in the society. Meeting of the energy needs of the population seems gigantic and the realization of this is found in the report of working group on Energy Policy set up by the Planning Commission as early as 1979 which acknowledged the energy crunch as real and confessed the lack of answer to the energy related problems. As far as the consumption of the energy is concerned, the household sector is the largest consumer accounting for about 50 per cent of total non-commercial energy consumption. Most of the energy used in this sector is in the form of non-commercial energy, such as firewood, agricultural waste and animal dung (Planning Commission 1979) though at times prices are paid. Of late there has been a trend towards increasing use of commercial energy in the household sector from electricity, coal, kerosene and liquified petroleum gas (Table 1). The rural areas, accounting for 74 per cent of the total population of the country, presents a scene more critical than the urban counterpart. Low purchasing power, higher share of non commercial energy, small requirement in terms of population as well as area, low private cost of procuring energy and supply difficulties are few distinctive features of energy scene in villages.

Though energy is required for a variety of purposes in the households namely cooking, lighting, heating and cooling etc., the need for cooking and lighting is universal and substantial. Cooking as a single most important activity in the household draws heavily on energy resources. The use of fuel, which provides the energy for cooking, not only varies between urban and rural areas but also depends to a great extent on socio-econom ic character

*Senior Research Officer, Population Research Centre, CRRID.
** Research Associate, Population Research Centre, CRRID.

t Revised version of the paper presented in the seminar on *Women, Poverty and Demographic Change* held at Oaxaca, Mexico, 25-28 October 1994 organised by IUSSP Committee on Gender and Population in cooperation with El Colegio de Mexico, SOMEDE, COESP-CONAPO and State of Oaxaca.

of the households and physical environments. For example, more members in the house means more of cooking and a cold climate outside demands frequent heating inside. Among various types of fuel used in Indian homes, fuelwood and animal dung are important sources of energy for the rural area and, to some extent, in urban households also. They are supplemented by crop residues and other bio masses in meeting the domestic energy needs coming from hearths in rural areas.

TABLE 1: PER CENT SHARE IN FINAL COMMERCIAL ENERGY CONSUMPTION BY SECTOR

Sector	1953-54	1960-61	1970-7-1	1980-81	1990-91
Industry	39.8	40.7	51.6	57.0	50.4
Transport	46.2	44.9	29.4	23.5	24.5
Household	9.9	10.6	14.3	12.3	13.8
Agriculture	1.7	1.8	3.8	6.1	9.0
Others	2.4	2.0	0.9	1.1	2.3

Source: Eighth Five Year Plan (1992-97), Planning Commission, New Delhi.

The production and consumption of energy is systematically linked with the ecological environment. Energy consumed in all the major sectors such as industry, agriculture, transport and household are generated from different kinds of resources of earth, both stock and flow; finite and infinite. In ultimate analysis the destruction of forests, damage to the bio mass cover, degradation of the soil and water resources and deprivation of the soil from the availability of wet dung as a valuable organic manure all have been related to the process of energy extraction of different types vital for the survival and growth of the society.

Predicament of Gender

A meticulous time budgeting of women's activities in an average Indian household singularly indicate the pre-ponderance of food preparation or cooking among a series of domestic chores performed by them from dawn to dusk. It is a paradox that the incidence of hunger makes cooking more demanding. In poor households, the physical burden of making meals ready for the family members is specially tormenting for the women members of the households. The domestic activities assume the characteristics of relatively being more arduous and laborious in abnormal situations and/or in villages with locational disadvantages—if one takes into account the basic natural resources needed for satisfying common needs.

Determined by culture, the division of labour, between women and men in different societies indicate exclusively gender rather than sex roles, though a relatively small amount of sexual characteristics enter into gender roles. Attempts by Murdock to observe 224 societies with a list of 46 activities, indicate some activities to be masculine and some including cooking to be exclusively feminine. For instance, cooking is exclusively feminine in 158 and masculine in 5 societies, in addition to grinding grain and carrying water (Rogers

1983). Cooking, as one of the major life supporting tasks, is solely a gender specific activity in all Indian homes. Though exclusive and primary responsibility of women, help is often forthcoming from other members in family particularly the female children. For instance, the folk tales and folk songs which reflect the culture and civilisation of Indian society, are laden with agonies of women's responsibility and ordeal associated with preparation of food as the following lines in a *Kannada* folk song translated into English (Tirumalesh 1990) portray:

> 'I am at the grind stone, the child on my lap!
> Do not argue with me, sister-in-law, I'll finish
> your work within the hour.
>
> Cry if you are tired, cry if you are bored,
> But not if I die, my mother!
> I will have done my women's term.
>
> The meal will be late in your mother-in-laws house! The
> child will be hungry, dear daughter, Take some sugar in
> your clothes.'

For an average family, cooking, to produce food in edible form, is final culmination of a chain of activities undertaken simultaneously or earlier. Fuel and water, two essential constituents need to be obtained in right quantity and quality, before cooking takes place and arrangement of these two vital resources on a daily basis is a time consuming as well as labour intensive phenomena requiring several hours a day. Fuel may be obtained in the form of firewood, dried cow dung or crop residue, and in far too many cases is becoming increasingly scarce and difficult to find. Fuel, especially wood, and water are very heavy and require strenuous effort to be carried to the place where food preparation is done. Finally, of course, there is cooking which with many staple foods takes a considerable time especially if fuel supplies need to be conserved (Rogers 1983: 153).

Natural Resources and Women

Resources are mainly matters of perception and their definition is dynamic. For instance, - ideas on what constitute the resources have altered dramatically over time, in response to, increased knowledge, technical improvement and cultural developments which have changed perceived needs. As Reeds (1990: 12) characterize:

> 'Two basic conditions must be satisfied before any element can be classified as a resource: first, the knowledge and technical skill must exist to allow its extraction and utilisation, and, second, there must be a demand for the materials or services produced. If, either of these conditions is not satisfied, then the physical substances remain "Neutral Stuff' (Zimmerman 1951 in Reeds 1990). It is, therefore, human ability and need which creates resource value not mere physical presence.'

Spurred by a whole lot of factors, the interest and anxiety in natural resources is not new and has been observed for ages. The altruistic usefulness of tropical forests in providing fuel, wood, timber, nuts, fruits, fodder and green manure in addition to promotion of climate, has made forests vital constituent of the resource base. In poor developing societies anxiety regarding dwindling forest appears to stem more from the concern for physical environment than the threat that the decline of the forests pose to the survival of the communities who have depended on forests forages. Examination of the social origin of the environmental impulse in India, not only point that environmental degradation and the ensuing resource shortages directly threaten survival and livelihood options, but also indicate about the clash of interests between peasants and industry over the productive resources (Gadgil and Guha 1994:132). Rapid industrialization, growth of the urban sprawl, monetization of rural economy, commercialization of agriculture and access restrictions have led to increased demand on forests and marginalized sections are forced to compete with capitalistic interests for benefit from forests. The reports of frequent clashes between forest guards and public is a testimony to the seriousness of social conflicts the shortages in natural resources can produce.

The example of communities which have been marginalized because of their poverty and have relied on forest resources to eke out a living are in abundance, and include tribal, nomads as well as villagers living in far flung areas with close vicinity to forests, be in plain or mountains.

Women, not only within these marginal cultures but in all rural cultures, face maximum threat (Aggarwal 1985: 301) as a result of depletion of forests, particularly in subsistence economies. Women in all these groups by virtue of their gender role and domestic responsibilities have been pushed to the border in their efforts to meet daily household needs from forest based resources. With active dependence on common property resources, the onus of collection of fuel is a primary responsibility of female members of the family, though some in their attempt to explode the popular myths contest the finding that women are the sole or primary collectors of fuelwood from forests and women work much longer hours than men. Marching out each day religiously in search of fuel, in spite of plentiful domestic chores lying unattended in home, demonstrates the pressure on their part to utilise the bio diversity. This sex specific disadvantage is reproduced in the concern the women generally have for forest resources. For example, in Himalayan district of Chamoli in UttarPradesh, discussions about which trees should be grown in village plantations showed that men preferred income producing fruit trees; the women, on the other hand, wanted trees to produce fuel and fodder (Eckholm e/ a/. 1984).

Though cooking is much more than mere collection of fuel for the household, sti'l kindling of the hearth in homes constitute a huge part of the cooking process. With living becoming much more precarious and task of forest related fuel collection being difficult, emotional outbursts are not unusual. In post colonial India the proof of sentimental involvement is amply demonstrated in the *Chipko* movement of Himalayan region taking place to stop trees from felling by embracing. Participation of large number of women from the surrounding villages in struggle to save forests from being cleared by contractors is a testimony of sustained grassroots struggles to protect forest from commercial exploitation (Shiva 1991) and women's concern for natural resources.

Data, Method and Limitations

This paper is based on data collected during a three year interdisciplinary research study *Peoples' Perception and Reproductive Behaviour in North West India* by the Population Research Centre (PRC), CRRID, Chandigarh for the Department of Family Welfare, Ministry of Health and Family Welfare, Government of India during 1990-93.

The study was carried out in a contiguous geographical belt forming a corridor in three north Indian states namely Haryana, Himachal Pradesh and Uttar Pradesh. A total number of 3739 rural and 1583 urban households were selected from 48 villages and eight towns of varying size, located in eight districts namely Karnal, Kurukshetra in Haryana, Bilaspur, Solan in Himachal Pradesh, and Dehradun, Haridwar, Saharanpur and Uttarkashi in Uttar Pradesh. The villages were selected at the level of developmental blocks, taking one from each block, while one town was selected from each district. In the selected villages all the households were approached for information gathering while in towns purposive random sampling of households was done.

The districts, located in two agro-ecological regions, out of the total twenty one in the country, represent social contrast and bio diversity of north India. For instance, districts namely Karnal, Kurukshetra and Saharanpur lie in the hot semi-arid eco-region with alluvium derived soil and have natural vegetation comprising tropical dry deciduous and thorn forests. Sixty five per cent of the area in this region is irrigated and the rest are under traditional rainfed agriculture. The common crop grown here are rice, wheat, maize, barley, pigeon pea, mustard, lentil and sugar cane. The climate here is characterised by hot, dry summer and cool winters. Bilaspur, Solan, Haridwar and Dehradun and Uttarkashi located in western Himalayas and are characterised by mild summer and cold winter. The temperature regimes in the region are determined by variable relief of landscapes. The natural vegetation comprises Himalayan moist temperate, subtropical pine and sub-alpine forests. Rainfed farming is the traditional practice and dominantly practised in valleys as well as on terraces. This agro ecological setting has a role in ever increasing demand for food, fodder, fibre and particularly fuel experienced in the study region because it is the immediate vegetation on which the supply burden falls.

A set of comprehensive questionnaire which were used by a team of well trained investigators to collect information on social, economic, health and demographic situation of the area under investigation included the 'Household Schedule'. This schedule recorded detailed information on aspects of household dynamics including fuel conditions.

The respondents were asked about the procurement and use of fuel for cooking in the households. Though more than a single type of fuels are often used in the hearths, the women members were advised to report the dominant fuel in terms of use intensity and duration. Often separate types of fuel are used in Indian households for different purposes indicating thereby relative importance of each purpose and corresponding fuel. For example, a family may use sugarcane stalks to boil water for bath, sawdust stove to warm the room in winter and firewood to cook food. Such multiplicity of fuel use of course was not aimed to be captured by the questionnaire given the inability of respondents to apportion fuel mix.

The sorting of fuels into different distinct types as have been done in this exercise may not be prudent, particularly when the category firewood is taken into account. The condition in the many village is such that a lot many households cook with organic materials such as dried leaves, sugar cane stalk, stem, bagasse, scrub, straw, crop residues and agricultural waste but for the purpose of analysis all these low grade fuels were subsumed in firewood category which implies chopped wood of better quality. Hence, firewood as a bulky category should not form the impression about exclusiveness of wood. For low income and landless families the fuel mix is so thick and fast that a broad division is not only meaningful but valid also.

Though in a conventional classification system bio gas as an encompassing category also includes *gobar* (cow dung)gas, an attempt was made to collect data separately for both the types to comprehend the extent to which agricultural and other organic waste particularly the night soil, other than the cow dung, go into production of bio gas. The fallout of this finer distinction is that the figures in respective category often tends to be incredibly small.

For basic analysis two way classification of study area and fuels used was attempted. Basing on overall physiography, the region was divided into hill and plain, and the sampled households were adjusted accordingly depending on the location of the corresponding village/town. Grouping of villages and towns on the basis of topography rather than rural and urban dichotomy was preferred since socio-economic conditions, settlement pattern, life style, environmental conditions as well as priorities vary a great deal between hills and plains. Such a bisection is expected to usher better understanding of dynamics of fuel consumption. Moreover, fears of losing the inherent cleavage between urban and rural living styles for certain districts namely Karnal and Uttarkashi also support this splitting up. In these districts the urban units Gharaunda and Barkot respectively selected for the sample are simply urban because of definitional adherement and not because of definite and distinctive lifestyle resulting from the penetration of urbanism. Jhabrera in Haridwar being a Census Town is a case in point as it has been declared urban in spite of partially fulfilling laid definitional norms. Moreover, with physiography at the hub of demarcation, the interaction with environment gets prominence.

Likewise, all the seven kinds of fuel used for cooking were classified into two categories viz.: modern and conventional. While firewood and cow dung were treated as conventional or traditional; *gobar gas,* bio gas, kerosene, liquified petroleum gas, electricity and kerosene were included in the category of modern fuel. This division was done on the basis of criterion of fuel efficiency, technological input, household preferences, accessibility, potential threat to environment as well as user's friendliness in terms of drudgery and impact on health. This broad division indeed helps to analyze the data and relate the fuel condition with socio-economic milieu of the respective households.

Regional Pattern of Fuel Consumption

The fuel consumption pattern at national level presents a diverse scene. For instance, the data from the 1991 Census on the type of fuel used for cooking in the households, available

for the first time as part of the exercise to assess the housing and amenities facilities, show that a considerable heterogenity exists in the country both on caste line and regional level.

Of eight types of fuel viz.: cow dung cake, electricity, coke/coal/lignite/charcoal, cooking gas, wood, bio gas, kerosene and others generally used in the Indian households, wood is most prominent followed by cow dung cake. More than three-fifth households (61 per cent) use wood as fuel and near about 15 per cent depend on cow dung. Browsing of State level figures brings to the fore the inter-state divergence in fuel mix which appears to be largely rooted in the local environment. For example, the fuel consumption statistics for Kerala, Tamil Nadu and Andhra Pradesh in south; Himachal Pradesh in north, and Assam, Nagaland, Manipur, Tripura, Arunachal Pradesh and Meghalaya in north-east India where more than 80 per cent households bank on wood for domestic fuel testifies unequivocally the importance of wood as primary source of domestic energy. Since, except for Tamil Nadu, these are the States with relatively higher share of forests in the total area of the State, preeminence of wood among all types of domestic fuel has explicit ramifications for environment. Likewise, cow dung, the second most important fuel in India, finds wide application in homes of Uttar Pradesh (37 per cent), Bihar and Punjab (35 per cent each) and Haryana (26 per cent). Given the enormous reliance on these two fuels, firewood and cow dung can be contemplated to portray the ethos of rural India (Bose 1994).

The Table 2 shows the fuel consumption pattern in three north Indian States in which all the sampled villages and towns are located and provides background to the study area. The consumption of wood and dung cake is higher in rural areas as compared to urban and among the socially backward low income scheduled caste and scheduled tribe households. The extensive consumption of fuels such as wood and cow dung which are chiefly non commercial and traditional, mirror not only the relative disadvantages of these deprived section but also the pressure on environment, more so, in rural areas.

The energy use pattern in the Indian villages are determined by factors such as type and extent of forest cover, access, availability of common land, proximity to urban areas, population density, agrarian pattern and local tradition (Ramakrishnan 1994). As an outcome, vast differences in levels of energy consumption and nature of fuel used for production of cokking energy are observed among different village eco systems. Besides inter and intra village discrepancy in terms of fuel use and energy consumption, a great deal of inter-household energy production also exists which can be evidenced against the backdrop of income, occupation, wealth possession and other indices. Hence, the use of fuels in the house not only reflects the economic condition but also the levels of modernisation in respective households (Nanda 1993).

There is a clear-cut distinction in the fuel use configuration between hill and plain areas as noticeable from the Table 3. While the households in hilly areas are labelled by exclusiveness of firewood, the dominant fuels in the plains are cow dung and firewood. It is astonishing to note that not even a single household in hilly areas reported using cow dung during the survey. Since in hilly areas wood is locally available from the nearby forests; perhaps freely with less effort, and no need for transport, the incentives to use woodfuel are, understandable. Whether such excessive consumption cause forests to recede and damage

TABLE 2: PER CENT DISTRIBUTION OF HOUSEHOLDS BY TYPE OF FUEL USED FOR COOKING

Stale/ India	*Rural/ Urban*	*Cowdung Cake*	*Electri- city*	*Coal/Coke/ Lignite*	*Cooking gas*	*Wood*	*Bio gass*	*Kerosene*	*Others*	*Total*
All										
Haryana	Rural	31.78	0.14	0.58	1.85	63.02	0.24	1.28	1.07	100.00
	Urban	12.13	0.14	3.02	41.95	23.42	0.65	17.77	0.81	100.00
	Total	26.36	0.14	1.26	12.91	52.10	0.35	5.82	1.00	100.00
Himachal	Rural	0.15	0.40	0.66	2.11	90.70	0.39	5.36	0.23	100.00
Pradesh	Urban	0.22	1.12	0.82	40.31	15.31	0.84	40.60	0.78	100.00
	Total	0.17	0.48	0.67	6.37	82.30	0.44	9.28	0.29	100.00
Uttar	Rural	43.62	0.18	0.57	0.63	52.93	0.16	0.68	1.15	100.00
pradesh	Urban	10.01	0.64	7.63	25.58	39.66	0.54	14.76	1.00	100.0
	Total	37.14	0.26	1.94	5.44	50.37	0.24	3.39	1.12	100.00
India	Rural	19.60	0.16	1.95	1.22	71.69	0.43	1.34	3.59	100.00
	Urban	3.51	0.72	10.72	26.93	32.74	0.68	23.62	1.00	100.00
	Total	15.39	0.31	4.24	7.94	61.50	0.49	7.16	2.91	100.00
Scheduled Caste										
Haryana	Rural	34.83	0.11	0.54	0.33	63.10	0.05	0.55	0.46	100.00
	Urban	24.33	0.11	4.02	7.68	51.12	0.14	11.82	0.62	100.00
	Total	33.02	0.11	1.14	1.59	61.03	0.07	2.50	0.48	100.00
Himachal	Rural	0.10	0.19	0.87	0.69	94.98	0.20	2.81	0.16	100.00
Pradesh	Urban	0.21	0.90	1.20	7.42	32.03	0.21	46.83	1.14	100.00
	Total	0.11	0.24	0.89	1.80	90.80	0.20	5.73	0.22	100.00
Uttar	Rural	44.68	0.09	0.49	0.23	53.11	0.09	0.28	0.98	100.00
pradesh	Urban	14.44	0.50	9.41	12.00	50.66	0.33	11.38	0.98	100.00
	Total	4 1 .08	0.14	1.55	1.63	52.82	0.11	1 .60	0.98	100.00
India	Rural	24.78	0.14	1.87	0.37	67.69	0.14	0.66	4.33	1 00.00
	Urban	6.29	0.47	13.56	10.23	45.83	0.37	21.89	1.25	100.00
	Total	21.42	0.20	3.99	2.16	63.72	0.18	4.51	3.77	100.00
Scheduled Tribe										
Himachal	Rural	1.29	0.13	0.38	0.81	92.00	0.07	5.12	0.19	100.00
Pradesh	Urban	0.11	0.78	1.12	26.52	16.53	2.85	50.36	1.62	100.00
	Total	1.24	0.16	0.42	1.95	83.67	0.19	7.11	0.25	100.00
Uttar	Rural	26.42	0.46	0.85	1.27	67.29	0.15	1.61	1.77	100.00
Pradesh	Urban	9.24	0.75	10.75	24.78	32.90	0.28	19.20	1.61	100.00
	Total	20.84	0.55	4.07	8.90	56.12	0.19	7.26	1.72	100.00
India	Rural	5.34	0.05	0.94	0.24	90.72	0.15	0.41	2.13	100.00
	Urban	2.83	0.75	13.58	9.98	53.08	0.26	18.20	1.23	100.00
	Total	5.13	0.11	2.02	1.07	87.51	0.16	1.93	2.05	100.00

Source: Housing and Amenities. Paper 2 of 1993. Series 1, Census ofIndia 1991.
Note: The figures for 'Total' do not add to 100 as some households do not cook.

TABLE 3: PERCENT DISTRIBUTION OF HOUSEHOLDS BY TYPE OF FUEL USED FOR COOKING CLASSIFIED BY REGION

Type of fuel	*Region*		*Total (N)*
	Hill	Plain	
Firewood	700(65.85)	1943(45.62)	2643 (49.67)
Gobar gas	10 (0.94)	46 (1.08)	56 (1.05)
Biogas	8 (0.75)	15 (0.35)	23 (0.43)
Natural gas	198(18.63)	535(12.56)	733(13.77)
Electricity	7 (0.66)	36 (0.85)	43 (0.81)
Kerosene	140(13.17)	207 (4.86)	347 (6.52)
Cow dung	0 (0.00)	1477 (34.68)	1477 (27.75)
All	1063 (100.00)	4259 (100.00)	5322(100.00)

Source: Field survey 1991-92
Note: Figure in parenthesis indicate percentage of households in respective category.

the environment is a function of types of woodfuel collected. As revealed by the respondents, since most of the fuel gathering in hills is outside the designated forests and guards permit only to prune small branches, the environmental impact assessment is difficult.

A summary picture of fuel consumption situation in the households in the survey area is available from Table 4 below. If type of fuel used by the households is viewed either as modern or traditional depending on yardstick described subsequently, an interesting picture emerges as far as rural and urban dichotomy is concerned. For instance, firewood and cow dung, both of traditional kind, find excessive application as fuel in villages as opposed to kerosene, electricity and natural gas (LPG) in towns and cities. More than three-fifth of

TABLE 4: PER CENT DISTRIBUTION OF HOUSEHOLDS CLASSIFIED BY TYPE OF FUEL USED I OR COOKING AND PLACE OF RESIDENCE (REGION)

Type of Fuel	*Number of households (N)*		
	Rural	*Urban*	*Total*
Firewood	2115 (24.56)	528 '(33.35)	2643 (49.67)
Cow Dung	1395 (37.31)	82 (5.18)	1477 (27.75)
Gobar gas	51 (1.36)	5 (0.32)	56 (1.05)
Bio gas	10 (0.27)	13 (0.82)	23 (0.43)
Natural gas	98 (2.62)	635 (40.11)	733 (13.77)
Electricity	13 (3.35)	30 (1 .90)	43 (0.81)
Kerosene	57 (1.52)	290 (18.32)	347 (6.52)
All	3739(100.00)	1583(100.00)	5322(100.00)

Source: Field survey, 1991-92.
Note: Figure in parenthesis indicate percentage in respective category

households in rural areas depend on these two fuels as against less than two-fifth in urban areas. Moreover, relatively higher share of natural gas as domestic fuel in urban households (40 per cent) as compared to rural (3 per cent) bring to the centre stage the striking reality of how a most modern fuel continues to be out of reach of rural community. This speaks of the fact that the rural sector still depends to a huge extent for energy on traditional and forest related sources having direct impact on environment in contrast to the urban sector.

Rural areas present contrasting picture as compared to the urban areas and use pattern vary from district to district (Table 5). Firewood and other biomass residues are the single major source of fuel in majority households except for the villages selected in the sample from Karnal and Kurukshetra. The overwhelming dependence on cow dung in these two districts can be attributed to better cattle holdings. The hilly districts are marked by their exclusive reliance on woodfuel as revealed by a majority of households in Uttarkashi (92 per cent), Dehradun (87 percent), and Solan (72 percent). Even the districts located closer to the forests also have higher incidence of fuelwood consumption as one finds in Saharanpur (68 per cent) and Haridwar (57 per cent) and all this can be ascribed to easy approachability to the source, that is forest.

Cattle dung, known as Gobar in local language, mainly from buffalo and cow, is the major source of fuel in the plains and retains popularity in rural areas. In the districts of Karnal and Kurukshetra, 82 and 60 per cent of the households in the rural areas use the dung respectively. A fairly large number of rural households also use dung in Haridwar (43 per cent) and Saharanpur (31 per cent). Since most of these districts are located in the green revolution belt, the fodder for the animals is easily available. Moreover, the commercialization of agriculture and rapid rise in milk production in these prosperous districts have enhanced the worth of the livestock holdings. But in hilly area, given the constraints of rearing animals, one finds virtual non existence of dung as fuel. The districts located in Himalaya hills namely Bilaspur, Solan, Dehradun and Uttarkashi are conspicuous by total non use of animal dung as fuel both in rural as well as urban areas. The perpetual scarcity of fodder and special problems of shelter in winter makes it difficult for rearing the bovines in large numbers so as to get adequate quantity of dung. Moreover, if one can collect dried branches, leaves and other biomass from the surrounding—the lack of availability of dung is easily compensated. Among the livestock, sheep are mainly reared for wool required in harsh winter and the goats for money and meat. The urban areas are marked by extremely low use of dung for fuel purposes. The difficulty of arranging sheds, finding grazing land, devoting time towards tending the cattle and availability of other fuels etc. reduces the need for cow dung in towns and cities. In addition, use of animal dung as fuel is not only inconvenient but also thought to be of low social status.

Closely associated with the availability of cow dung is thegoAargas. Even if use of dung, directly as fuel, is widespread in the green revolution belt, on the whole very few households were found to process the dung so as to generate the combustible gas for cooking. This shows that gobar gas plants, accompanied by their associated technology, enable the dung to be used for fuel without foregoing the nutrient as manure but this fact is yet to permeate the realm of rural awareness. The reasons are not far to seek: insufficient livestock holding, inadequate

TABLE 5: PERCENT DISTRIBUTION OF HOUSEHOLDS BY TYPE OF FUEL USED FOR COOKING

District	Rural Urban	Type of Fuel							
		N	Fire wood	Cow dung	Gobar gas	Bio gas	Natural gas	electri-city	Kerosene
Karnal	(R)	621	9.2	82.8	3.5	0.3	2.7	0.5	1.0
	(U)	150	44.7	28.0	0.0	0.0	16.0	0.0	11.3
Kurukshetra	(R)	580	34.1	60.5	1.4	0.0	1.0	0.3	2.6
	(U)	240	20.8	7.1	0.0	0.0	43.3	4.2	24.6
&\ta&f*»	W	130	92.3	0.0	3.1	0.0	3.1	0.0	1.5
	(U)	103	15.5	0.0	1.9	1.0	49.5	0.0	32.0
Solan	(R)	159	72.3	0.0	0.0	2.5	20.1	0.0	5.0
	(U)	85	14.1	0.0	0.0	0.0	51.8	0.0	34.1
Dehradun	(R)	436	87.1	0.2	1.4	0.5	5.5	0.9	4.4
	(U)	276	27.5	0.0	0.4	1.1	53.3	4.3	13.4
Haridwar	(R)	506	57.3	42.5	0.2	0.0	0.0	0.0	0.0
	(U)	154	46.1	9.7	1.3	5.8	31.2	0.0	5.8
Saharanpur	(R)	1023	68.0	30.7	0.8	0.1	0.2	0.1	0.2
	(U)	422	41.7	1.9	0.0	0.0	41.7	0.9	13.7
Uttarkashi	(R)	284	91.5	0.0	0.7	0.4	4.6	1.1	1.8
	(U)	153	39.2	0.0	0.0	0.0	26.8	2.6	31.4
Region	(R)	3739	56.5	37.3	1.4	0.3	2.6	0.3	1.5
	(U)	1583	33.4	5.2	0.3	0.8	40.1	1.9	18.3

Source: Field survey, 1991-92.

quantities of dung produced by the animals in a household, location of the plant, immediate storage of the slurry coming out of the plants, frequent break down of existing plants, lack of an effective agreement on sharing the gas from plant are few obstacle in popularization of gobar gas plants. Though in theory there is a provision of family size bio-gas plants and community or institutional bio gas plants to suit the cattle holding of the respective house, in practice one finds little traces of either in villages. It was only in Devpura village of Saharanpur a free gohar gas plant provided by the government was found to be functional. Though only four households in Prahu village in Bilaspur district had got together to install a plant with a cost of Rs. 5,500, they often also depended on firewood because of frequent breakdown of the plant. Generally the dung from two to three cattle produces the gas which is adequate to meet the cooking fuel requirement of a family consisting of three to four persons per day but given the average household size and constant demand for fuel round the clock, the plants fail to meet the energy requirement. Dung accumulation ordinarily being a rural activity, the gobar gas plants were confined more to the rural areas as compared to the urban areas. Out of 42 only 13 villages were reported to have gobar gas plants, that too in extremely small number of households. Relatively larger number of rural households in Karnal (3.5 per cent) and Bilaspur (3.1 per cent) were found to use gobar gas. Analysis of

household livestock holding position show that a great majority of households, i.e. 32 out of 44 in rural and 3 out of 5 in urban area had more than two cattle in them. So what seems a pre-condition for success in this fuel is, the ownership of cattle holding which is again an expensive proposition. The incentives from the institutional sector for promotion of this plants were not forthcoming as one comes across only one case of financial help from local bank specifically for the purpose of installation of plant.

The commercial fuels such as liquified petroleum gas, electricity and kerosene which are centrally controlled and supplied are major sources of energy in the urban area. Concentration of natural gas in urban homes is uniform across all the districts though inter-district variations do persists. The higher user rates of bottled gases (LPG) in Kurukshetra, Bilaspur, Solan, Dehradun and Saharanpur is due to selection of towns where most of the working male population is in tertiary sector particularly either in trade and service or in public sector employment. Economic affluence, greater awareness and increased manipulative ability etc. partially justify such a higher user rate of LPG. With limited quota allotted for rural areas, bureaucratic application procedure and long waiting time-at times over a decade-for cooking gases at delivery outlets, the impediments to expansion in utilization of an efficient fuel is enough. Instances of many disappointed households were recorded during field visit. Because of high tariff rates per unit of consumption, electricity is relatively dearer than other type of fuels. In addition to the cost disadvantage, the supply of power is erratic in most villages and towns, particularly during summer, when one has to go without it for hours and even days. This obviously ends in less reliance on it for urgent and regular activities like cooking. Hence, its use seems to be minimal in rural and urban areas of all districts surveyed. Irrespective of districts, kerosene oil another cheap source of energy is mostly limited to the rural than urban households who of course have better access to public distribution system.

Household Level Consumption

In Indian setting the type of fuel used for cooking in a household is decided by a host of forces operating both at household as well as environmental level. Economic status of the household particularly the ownership of agricultural and non agricultural land, disposable money income; social factors like educational attainment of the family head and other members, religion and caste; and demographic background such as household membership, place of residence and sex ratio are believed to determine the fuel use practices in cooking.

In order to ascertain the link of socio-cultural and economic status of the household with the pattern of domestic fuel usage, attempt was made to know whether the recourse to a particular type—either conventional or modern, in the household is affected by some salient socio-cultural and economic indicators. In fact, the analysis of test of difference in means and proportions for both the hill and plain areas separately reveals a robust association between the socio-economic position and the selection of fuel. The nature of the affinity between the two is again on the expected lines where poverty manifests through diverse facets.

In Table 6, comparison of means between households using modern and conventional fuel for selected quantifiable economic characteristics indicate that the use of superior or

TABLE 6: TEST OF DIFFERENCE IN MEANS OF HOUSEHOLDS USING MODERN AND CONVENTIONAL FUELS FOR SELECTED SOCIO-ECONOMIC CHARACTERISTICS (REGION)

Background Characteristics	Category offuel	Hill			Plain		
		Mean	Standard deviation	Z value	Mean	. Standard deviation	Z Value
Income	Modern	2171.68	1566.07	13.21**	2352.02	3036.20	7.03**
(in Rs./month)	Conventional	962.83	1062.93	1543.94	2763.57		
Landholding	Modem	0.59	1.81	4.28**	1.42	5.95	4.58**
(in hectares)	Conventional	1.19	2.73		2.52	7.29	
No. of rooms	Modern	2.X4	2.38	-0.60	2.56	1.04	8.96**
in house	Conventional	2.93	2.15		2.16	1.55	
Household	Modern	4.93	2.56	-6.63**	5.70	2.35	-3.93**
	Conventional	6.13	3,21		6.07	2.80	
Sex ratio	Modern	1003.00	743.82	-1.97*	1131.00	875.36	1.89
	Conventional	1101.00	810.73		1068.00	823.50	
N	Modern		363			839	
	Conventional		700			3420	

Note: *=p< 0.05 and ** =p< 0.01
Z = (X m- X c) Standard Error
Xm =Mean of selected socioeconomic characteristic for households using, modern fuel
Xc =Mean of selected socioeconomic characteristic for households using conventional fuel

inferior type of fuel is associated with factors like money income, size of operational landholding, number of rooms in house, membership size and sex ratio. All these factors, barring number of rooms and sex ratio, seem to be equally vital both in plain and hilly areas as indicated by their level of significance. While, sex ratio is significant in hills, number of rooms is important in plain areas. The households using conventional fuel in hilly areas not only have higher sex ratio but also less monthly income. Tough living conditions in these areas demand more to be appropriated from local environment for sustenance and presence of more female members in the home comes handy for such work involving long hours. So the significance of sex ratio can be viewed through the survival strategies of poor families in hills.

For all the conventional domestic fuel users, the segregation of households in the plain and hilly areas on the basis of some selected socio-economic attributes bring to fore the correlation between levels of economic development and nature of fuel consumption. In most comparisons of the proportions for two groups based on any social or economic indicator, it is those who are in the lowest rung of the society by virtue of their poor economic or social standing, turn out to be users of less efficient traditional fuels. Significance of caste is clear from the fact that the tribal households in hilly areas are more marked by wide use of conventional fuel consisting of firewood (Table 7). Vulnerability in living condition, indicated by assets of modernization and access to basic amenities, also show eloquent

TABLE 7: TEST OF DIFFERENCE IN PROPORTION BETWEEN GROUPS OF HOUSEHOLDS USING CONVENTIONAL FUEL FOR SELECTED SOCIO-ECONOMIC CHARACTERISTICS (PLAIN)

Background Characteristics	(N)	Groups	P1	P2	P	q	S.E	Z
Socio-cultural								
Religion								
Hindu	(2762)	Hindu Sikh	0.79	0.79	0.79	0.21	0.02	0.00
Sikh	(294)	Hindu Muslim	0.79	0.90	0.80	0.20	0.02	-4.79**
Muslim	(305)	Sikh Muslim	0.79	0.90	0.84	0,16	0.03	-3.82**
Caste								
Scheduled Caste	(1193)	SC/ST	0.93	0.99	0.93	0.07	0.03	-2.09*
Scheduled Tribe	(83)	SC/Non SC & ST	0.93	0.72	0.79	0.21	0.01	15.04**
Non SC&ST	(2891)	ST/Non SC & ST	0.72	0.99	0.73	0.27	0.05	-5.41**
Assets of Modernization								
Tractor	(280)	Yes/No	0.86	0.78	0.79	0.21	0.02	3.07**
Pump set	(788)	-do-	0.91	0.76	0.79	6.21	0.02	9.56**
Motor vehicle	(224)	-do-	0.44	0.84	0.79	0.21	0.02	-20.49**
Sewing machine	(1403)	-do-	0.68	0.89	0.79	0.21	0.01	-16.39**
Refrigerator	(73)	-do-	0.24	0.83	0.79	0.21	0.02	-24.88**
Pressure cooker	(566)	-do-	0.44	0.94	0.79	0.21	0.01	-36.68**
Radio	(948)	-do-	0.64	0.87	0.79	0.21	0.01	-17.51**
Television	(888)	-do-	0.56	0.92	0.79	0.21	0.01	-28.03**
Type of Basic Amenities								
Type of house								
Pucca	(1627)	Pucca/Semi Pucca	0.67	0.92	0.73	0.27	0.02	-12.90**
Semipucca	(612)	Pucca/Kutcha	0.67	0.95	0.76	0.24	0.02	-18.21**
Kutcha	(1063)	Semi Pucca/Kutcha	0.92	0.95	0.94	0.06	0.01	-2.53**
Accessibility of drinking water	(2832)	Easy/Arduous	0.77	0.95	0.79	0.21	0.02	-9.98**
Source of drinking water	(3063)	Safe/Unsafe	0.78	0.97	0.79	0.21	0.02	-32.29**
Other								
Newspaper reading	(264)	Yes/No	0.44	0.85	0.79	0.21	0.02	-22.34**

Notes: * =p<0.05 and ** =p<O.OI

Pi = Proportion of 'households in the /th group using conventional fuel to the total households in the /th group = Xc / Ni, where i =1,2.

p = Proportion of 'households in first and second group using conventional fuel to the total households in both groups = (X1 + X2)/(N1 + N2,).

q= 1-p

- = (P1, -P2,)/ Standard Error.

TABLE. 8: TEST OF DIFFERENCE IN PROPORTION BETWEEN GROUPS OF HOUSEHOLDS USING CONVENTIONAL FUEL FOR SELECTED SOCIO-ECONOMIC CHARACTERISTICS (HILL)

Background Characteristics	*N*	*Groups*	P_1	P_2	*P*	*q*	*S.E.*	*Z*
Socio-cultural								
Religion								
Hindu	(676)	Hindu/Sikh	0.67	0.11	0.66	0.34	0.16	3.52**
Sikh	(1)	Hindu/Muslim	0.67	0.62	0.67	0.33	0.08	+0.61
Muslim	TO	Sikh/ Muslim	0.11	0.62	0.51	0.49	0.19	-2.70**
Caste								
Scheduled caste	(137)	SC/ST	0.75	0.88	0.80	0.20	0.05	-2.60**
Scheduled tribe	(110)	SC/Non SC & ST	0.75	0.60	0.63	0.37	0.04	3.67**
Non SC & ST	(455)	ST/Non SC & ST	0.88	0.60	0.64	0.36	0.05	5.99**
Assets of Modernization								
Tractor	(0)	Yes/No	0.00	0.66	0.66	0.34	0.47	-1.40
Pumpset	(2)	-do-	1.00	0.66	0.66	0.34	0.34	1.02
Motor vehicle	(15)	-do-	0.18	0.70	0.66	0.34	0.05	-9.82
Sewing machine	(248)	-do-	0.51	0.79	0.66	0.34	0.03	-9.48**
Refrigerator	(6)	-do-	0.09	0.70	0.66	0.34	0.06	-10.50**
Pressure cooker	(186)	-do-	0.43	0.82	0.66	0.34	0.03	-12.93**
Radio	(314)	-do-	0.52	0.85	0.66	0.34	0.03	-11.28**
Television	(124)	-do-	0.33	0.84	0.66	0.34	0.03	-16.68**
Type of Basic Amenities								
Type of house								
Puccca	(330)	Pucca/Semi Pucca	0.51	0.82	0.58	0.42	0.04	-7.52**
Semi pucca	(156)	Pucca/Kutcha	0.51	0.93	0.61	0.39	0.04	-10.08**
Kutcha	(169)	Semi Pucca/Kutcha	0.82	0.93	0.87	0.13	0.03	-3.12**
Accessibility of drinking water	(462)	Easy/Arduous	0.59	0.91	0.66	0.34	0.04	-8.87**
Source of drinking water	(502)	Safe/Unsafe	0.59	0.86	0.66	0.34	0.03	-8.21**
Others								
Newspaper reading	(89)	Yes/No	0.36	0.75	0.66	0.34	0.03	-11.61**

Notes: *=p < 0.05 and ** = p < 0.01
p,=Proportion of households in the /th group using conventional fuel to the total households in the ith group = Xi/Ni, where i = 1,2.
p =.Proportion of households in first and second group using conventional fuel to the total households in both groups (X1+X2)/(N1 +N2).
q= l-p
: = (p_1-p_2,)/Standard Error.

caste reflect, to a great extent, the fuel choices as seen in the cases of Muslim and scheduled caste households who invariably are more aligned towards woodfuel and cow dung. Among three major religious commun ities inhabiting the region, namely H indus, Sikhs and Muslims, the latter are found to be notable users of conventional fuels. This is not surprising in view of the fact that as a religious group relatively the Muslims have benefitted less from programmes of economic development and continue to be poor as compared to others. Studies conducted elsewhere in India have drawn attention to this fact systematically (Ahmed 1992). Similarly, the demarcations on the caste line are also glaring, as revealed by significant z-score, when comparison is made between scheduled caste and upper caste (non SC and non ST) households. Such an overlapping of social backwardness and use of less efficient-fuels can perhaps be explained by total disadvantageous setting such as landlessness, low income, retrogressive occupational structure, illiteracy, poor housing condition, ill health etc. in which these communities live. In fact, as a recognition of their all round underdevelopment, in many of the contemporary development programmes the scheduled castes are aimed as major beneficiaries. Ownership of durable consumption and productive assets ranging from tractor for cultivation to television viewing and newspaper reading habit which demonstrate the levels of economic well-being as well as modernization in the respective households also are tied to modes of fuel consumption. It is not surprising to observe from the calculated r-scores that the houses which lack these assets are the prolific users of the traditional fuels. Through multivariate analysis an attempt was made to indentify the relative importance of these factors in determining type of cooking fuel used in the household and logistic regression was thought to be appropriate statistical model for the purpose. Thus, the dependent variable considered was' 1' if the household used modern fuel and '0' otherwise, i.e. if it used conventional fuel. And independent variables were, those quantitative, qualitative and categorical, which were assumed to influence the type of fuel use. The explanatory variables were bunched into economic, cultural, demographic and basic amenities factors.

The results of logistic regression analysis are presented in Table 9 below for hilly as well as plain areas separately which show that the likelihood of households using modern type of fuel for domestic cooking is associated with social, economic, assets ownership, basic amenities and demographic variables. However, within these broad categories, the role and strength of each single factor differs depending on location of the household in hilly or plain area.

In the hilly areas the statistically significant variables are livestock holding, income, size of operational landholding (OLH), rural or urban location of the house, membership size, religion, caste, availability of electricity, toilet facility, and possession of consumers assets such as radio, television, refrigerator and pressure cooker. The effect of economic determinants such as livestock ownership, total income, size of operational landholding was found to be most important. For example, the regression coefficient suggests that when household transforms from non owner to owner in livestock such as cattle and bovines, the chances for the use of modern fuel declines by a factor of 0.156 as indicated by the negative sign. The odds ratio for income of the household suggests that, *ceteris paribus,* the odds of using

modern fuel are increased by a multiplicative factor of 1.001 with an unit increase in income. Similarly, the likelihood of urban households using modern fuel for cooking is 4.861 times higher as compared to rural households. Provision of basic amenities such as making electricity available to the houses increases the chances of using modern and efficient fuel by 2.674 times. Likewise, religion and caste also prove to be important ingredients thereby revealing their deterministic role in living conditions. For instance, when the households tend to be Muslim their odds of using modern fuel turn negative. This in fact, substantiates the economic plight of this minority. An analogous illustration from among the Hindus can also be made with reference to the socially and economically dispossessed scheduled castes. This group also has higher possibility of using traditional fuels as compared to upper caste Hindus. The remaining explanatory variables, namely ownership of motor vehicle and sewing machine, newspaper reading habit, type of house and number of rooms in it, type of family, sex ratio and existence of household industry, do not seem to have significant independent effect on the use of modern fuel for cooking in the households.

The situation is nearly the same in the plain areas although the circumstances differ. Here among socio-cultural variables, religion and caste are found to have impact on usage of fuel though their influence is relatively less powerful as compared to other economic and demographic characteristics. The negative 'beta' coefficient (-0.508) for Muslim households again indicates that they are much more prone to take recourse to woodfuel and cow dung than others and reflect the economic underdevelopment rather than any cultural rigidity associated with religion per se.

The primacy of economic determination is clear from the role of money income, status and size of operational landholding, and status and size of livestock holding which emerge as the crucial predictors of fuel condition in the households. With rise in income the households are anticipated to go for better variety of efficient fuels clubbed under modern category as opposed to the traditional fuels which are more likely to be in demand with increase in livestock as well as operational landholding and this is revealed from the respective odds for income (1.002), ownership of livestock (0.480) and size of arable land (0.911).

A majority of villages selected for the study under the plain area come under the green revolution belt of Haryana and western Uttar Pradesh where increased agricultural productivity and commercialization of cropping pattern has taken place phenomenally in last few decades abreat change in the life style of masses. With agricultural prosperity, the earnings of many families have risen, aspirations have altered and living conditions bettered in terms of housing, self provision of amenities and possession of assets. With all these transformations in process, fuel substitution in favour of modern fuels has also occurred. The rise in income is also expected to initiate a similar switch over to superior fuels in urban areas.

The size of operational landholding (OLH) also plays a decisive role in choice of fuels, with increase in landholding the probability of using inferior fuel in the households rises. This can perhaps be explained by the link of ownership of land with ownership of livestock on one hand and ownership of woodlot on the other. For rural areas, in most cases cattle ownership is decided by the land ownership because landless do not own draught animal

TABLE 9: LOGISTIC REGRESSION OF USE OF FUEL ON SELECTED SOCIO-ECONOMIC AND DEMOGRAPHIC FACTORS (REGION)

Background Characteristics	Hill				Plain.			
	Logistic Coeffnts.	Partial Correln.	Odds Ratio	P Value	Logistic Coeffnls.	Partial Correln.	Odds Ratio	P Value
Socio-cultural								
Religion		.094		.000**		.000		.201
Hindu	.052	.000*	1 .053	.939	-.174	.000	.841	.336
Sikh	.651	.000	1.917	.715	-.160	.000	.852	.482
Muslim (others)	-2.239	-.069	.107	.004**	-.508	-.023	.602	.036*
Caste		.075		.003**		.084		.084
Scheduled caste	-.787	-.067	.455	.004**	-.142	.000	.868	.688
Non SC & ST (Scheduled tribe)	.468	.053	1.596	.016*	.793	.027	2.209	.023*
Type of family		.035		.059		.000		.959
Nuclear	-.109	.000	.897	.664	.016	.000	1.016	.929
Extended (Joint)	.733	.032	2.082	.064	-.062	.000	0.940	.843
Economic								
Monthly income	.001	.096	1.001	.000**	.000	.050	1 .000	.000**
SizeofOLH	-.123	-.053	.885	.015*	-.093	.053	.911	.000**
Livestock owner	-1.857	-.171	.156	.000**	-.734	-.071	.480	.000**
Poverty line	.424	.000	1 .528	.232	.205	.000	1.228	.187
Household	.267	.000	1 .306	.518	-.406	-.012	.666	.105
Assets of Modernization								
Tractor	-.854	.000	.426	.981	-.091	.000	.914	.737
Pumpset	-5.559	.000	.004	.810	-.441	-.022	.643	.041*
Motor vehicle	.515	.000	1.674	.246	.641	.052	1.897	.000**
Sewing machine	.202	.000	1.223	.473	-.056	.000	.946	.689
Refrigerator	1.077	.017	2.937	.121	.847	.051	2.332	.000**
Pressure cooker	1 .339	.120	3.815	.000**	1.134	.116	3.108	.000**
Radio	.609	.046	1.839	.026*	.159	.000	1.172	.207
Television	.999	.085	2.716	.001**	.640	.066	1.896	.000**
Newspaper	-.140	.000	.870	.647	.444	.038	1 .558	.004**
Basic Amenities								
Household	.267	.000	1 .306	.518	-.406	-.012	.666	.105
Type of house	.013	.000	1.013	.972	.209	.000	1.232	.281
Number of rooms	.042	.000	1 .043	.501	.Oil	.000	1 O11	.775
Electric	.984	.059	2.674	.010*	-.022	.000	.978	.90^
Toilet facility	1.046	.096	2.845	.QOO**	.623	.056	1 .865	.00)**
Demographic								
Household size	-.176	-.079	.838	.001**	-.116	-.053	.890	.000**
pl. of res. (R/U)	1.581	.135	4.861	.000**	1.409	.115	4.091	.000**
Sex ratio	.000	.000	1 .000	.499	.000	.000	1 .000	.400
Constant	-3.293			.000	-3.193			.000**

Note: * =p < 0.05 and ** =p < 0.01

Variable in parenthesis indicate reference category.

though at times they have milk cattle in less number and in precarious condition (Jeffery *et al.* 1989). Once cattle is owned, the route to cow dung use in hearths is open and undisputed in rural setting. On the same count it is the owners of land who have greater and often exclusive access to firewood and other biomass for fuel. In the districts of Dehradun and Saharanpur relatively well off households reported that they procure firewood from forests in their own land. As a result of introduction of cash crops, particularly the sugarcane in this region which is economically much more profitable and less labour intensive, tremendous difference has taken place in fuel practices with farmers switching to sugarcane, Once harvested, the left over leaves and crushed canes dry in sun and become ready as fuel. Locally known as *Patti,* these residue are easily accessible to many households who grow canes in their field and landless families at a low price and big labour cost. Hence, ownership of land and extensive cultivation of sugarcane in western Uttar Pradesh and Haryana where the sampled villages are located interact to prompt the households to go for conventional fuel.

The agricultural prosperity has also induced a change in animal husbandry practice by making available vast infrastructure, better variety and improved quality of dry and green animal feeds. Efforts of operation flood have led to improved variety of cross bred cattle which can yield more milk. With demand for milk rising, selling of milk has been a good source of income and cows as well as buffaloes have become more productive than before. In fact, in rural areas one usually comes across households without agricultural land or none of the member in service, business or any other occupation, the references of which can be to female headed households. Dairy development is one way out of the poverty web and seems to positively improve the economic condition of many rural families over 70 per cent of whom are landless and small farmers (Achaya and Huria 1986). In such conditions one of the mechanism for livelihood is to raise cattle. Additionally, in the region understudy there are castes such as *Gujjars* whose family tradition and occupation is pastoral activity. As a result ownership of cattle have also multiplied and reverberations of this are seen in the large scale usage of cow and buffalo dung as fuel. This fuel comes automatically with the ownership of cattle, is easily available in the household, can be collected by family members particularly women and children with less labour input and no extra effort is needed for collection unlike fire wood. As far as collection is concerned no other type of fuel depend so much on women labour as cow dung and gives relief to adult males. So one finds in case of cattle owning households, even in the relatively better off ones, there is an innate aversion towards other types of modern fuel. Hence, unlike money income, the rise in affluence through livestock ownership is not necessarily associated with a shift towards use of more modern type of fuel. This is apparent from the negative value of logistic coefficient (-1.857) for livestock ownership.

Among a set of consumer durable assets-viewed to be belongings as well as agents of modernization-acquired by the households, ownership of any type of motor vehicle, refrigerator and pressure cooker, enhances significantly the options for a superior type of fuel. This is also true of television sets and newspaper reading habit. While the holdings of former types in a way reflect the advancement of cooking mechanism and affluence of the households, the latter category point towards social progressiveness of the respective

households. The greater predictive value of pressure cooker (odds 3.108) and refrigerator (odds 2.332) as far as fuel selection is concerned has to be interpreted cautiously given high degree of inter-collinearity between fuel use and upgradation of the cooking process.

The demographic factors such as family size and place of residence also prove to be decisive in system of fuel requirement. Notwithstanding the saving of fuel in large families arising out of complexities of economies of scale associated with cooking bigger meals, the commonplace logic implying greater demand for fuel in such households seems to be operative in the study region. The negative 'beta' co-efficient (-0.116) signals how the greater household size weakens the possibility of switching to superior type of fuels. The greatest big push to the use of modern fuels come from the change in place of residence of a household. As the odds denote, with the transfer of residence from rural to urban area, the prospects of going for more advanced type of fuel brightens by a factor of 4.091. In cities and towns relatively better awareness and education, high income and good supply network of efficient fuels like liquified petroleum gas, and greater accessibility of masses to wider public distribution system of retailing kerosene are some of the causes which give rise to acceptance of modern fuels. Nevertheless, the path for such a favourable impact is often perfunctory and situation in which most of economically weaker urban households use fuels other than fuewood and cow dung adduces about the deteriorating fuel scenario in towns and cities. Pressed with scarcity of firewood, in terms of both price as well as availability, and negligible infrastructure for cattle keeping, these households are forced to seek fuels other than cow dung and fuelwood. For instance, there are many poor households who can not afford to buy firewood at an exorbitant price and face the difficulty of using them in rainy season. The other demographic variable, the sex ratio of the household does not seem to be linked to the fuel use pattern in household.

Problems Galore

The rural fuel situation is broadly plagued by two type of problems, one relating to the entitlement and the other difficulties of use. The gamut of burden on masses vary from hardships in procurement, escalating prices and increasing health risks to inappropriate technological intervention, bureaucratic management of local community's access to forests, resistance to community empowerment and uneven allocation of common property resources.

Another problem lies in rapid commercialization of the rural economy. The survival economies typified by subsistence living, barter trading and extraction of material resources through self provisioning mechanisms etc. are being hit by monetization and as a result limited natural resources are diverted from directly sustaining human existence to generation of growth in the market economy (Shiva 1991). For a long time firewood, cow dung, agricultural and vegetable waste etc. have remained non commercial sources of energy for many in the villages and rural communities have absolutely no tradition of purchasing the fuel. Penetration of the market forces and a price tag to every sort of fuel-starting from crop residue to cow dung, previously unheard of in a society with history of tapping own and

common property resources for fuel, is a great shock. Even if the pricing of traditional items of fuel is accepted as a consequence of evolution of fuel market, there has not been commensurating rise in the purchasing power of local communities. Their economic hardship does not permit incurring of money expenditure on fuels, as items of daily consumption, when other necessities are to be given priority. So fuel goes to the bottom of shopping list.

The fact that the households are being compelled to pay more and more in terms of money forthe same type of fuel is an ample sign of crisis in the fuel market. During the survey the market rates at different places varied from Rs. 60-70 per 100 kilograms of firewood. There were numerous instances of families paying for dried cow dung cakes in villages as well as towns, and that too in the districts of green revolution belt namely Karnal, Kurukshetra, Saharanpurand Haridwar where a perceptible increase and improvement in the quantity as well as quality of livestock over the past few decades is supposed to enhance the supply of cattle dung and ease the pressure on demand. The prices of cow dung ranged from Rs. 15-20 per 100 dried cakes depending on the location of village and town.

The vagaries of weather also augment the hardship of collection and use of the fuels. Particularly the monsoon months are troublesome in gathering of the forest based fuel. With the lashing of incessant rain and water flooding everywhere not only collection but also drying of wood and animal dung in the sun. The need for storing of fuel becomes acute and a clear shortage of storage space in the house also makes storing difficult. Kerosene as an alternative fuel not only costs money but also becomes a scarce commodity during these days. The retail outlets of the Public Distribution System (PDS), being mostly ineffective, are unable to meet the needs of the villagers who need it first for lighting the lamps in the houses than as fuel for stoves.

As Subramaniam (1994) rightly points out, the approaches to energy crisis generated by deficits in fuelwood are typically characterised by over concentration of ameliorative actions on supply side and lack of demand management activities aimed at promotion of improved energy efficient stoves. Highlighting the fact that the women are active supporter of preservation of forest wealth, she exemplifies how the government sponsored programmes of improving/designing cooking stoves have not been accepted by women because of the reason that the new models fail to meet the needs and priorities of rural women. For instance, during field survey of Maheswari village in Haridwar district the investigators were shown improved models of stoves, provided by District Industries Centre which were not popular because of their heavy weight. Designing of the appropriate model seems critical in view of wide practice of traditional and inefficient methods which consist of 'Open Fire', 'Three Stone' and 'Horseshoe' shaped alcove made of mud and brick where 5-10 per cent potential energy in the wood is utilised during the cooking process.

Though not attempted to be investigated specifically for households, the health implications of methods of fuel use are definite and wide ranging, particularly in rural areas. The eye and lung diseases caused by kitchen smoke are common particularly among female members in the households who spent long hours with close proximity to hearths. Prolonged exposure to smoke emission and soot especially from wood, bio mass and cow dung,

Iggravated by ill designed hearths and stoves, lack of cooking space, improper arrangement for releasing smoke from kitchen, shortage of rooms, overcrowding also cause serious health lazard. In addition to causing heart ailment and chronic bronchitis, the various constituents jf smoke have other different ill effects. Carbon monoxide as an important constituent of woodsmoke reduces the haemoglobin content of the blood and increases the risks of anaemia particularly to rural, poor, illiterate and malnourished women. The effects on women and jnborn child are easily discernible as over a quarter of Indian women in the reproductive group are anaemic. Similarly, another constituent formaldehyde also causes irritation in the :yes, nose and throat; damages the tissues in lungs and exacerbates skin wounds (Sugumar 1990). Like woodfuel, the harmful impacts of dung collection and use needs to be medically issessed in view of their extensive utilisation as fuel. The wet collection of cow dung and the 'requent contact with the skin possesses risks of skin infection, worm infestation and tetanus. Phe drying and storing of cow dung so close to the place of stay as is the general practice also i considerable health threat. In a situation where it is difficult to afford to pay for fuel and ack of availability of alternate fuel like kerosene, the households are hard pressed to use lealth risk fuels in a non efficient manner. It is but natural that health of women in economically weaker sections is a casualty.

yrhe use of dung as fuel is an arduous and time consuming process. It has to be collected vet, manually, pooled, moulded into different sizes as per the requirement and dried before >eing finally ready for the hearth. Collection of fresh dung outside the sheds is hard as :ompared to that from inside. Being boring and labour intensive the burden of gathering generally falls on the females. Often the females and children have to follow the herds so that hey can collect the droppings which the animals leave on their wake go as far as they can n search of the dung. In rural areas it is not uncommon to find them with head loads of dung, leffery *etal.* (1989) in their discussion on women's work and rural development in Bijnor iraw attention to the exclusiveness of female labour input going into much of the dung work vhich is 'productive' as well as 'reproductive' in theoretical perspectives of development :conomics. The drying is a problem in rainy days specifically when there is no adequate sun md space. One could see in the villages every conceivable space specially walls as well as >avements orderly stuck with cakes of varying size for drying. In a time when the organic nanure is being promoted in a big way the, the dung has a better alternate use in the farms md as a realization of this decline of dung as fuel is appearing. This has affected the poorer lections of the society, who earlier were getting free dung. Either they are not getting them >r have to pay a price for it now a days. During the field survey the instances of sharing and >aying for dung by poor was plenty. In Jhabrera town in Haridwar district, accounts of andless labourers particularly those belonging to scheduled caste community, being paid ;rain and cow dung instead of cash as daily wages is signs of desperation for the poor.

Eluding Solution

The energy programme in India got a fillip in early eighties with the stimulation coming rom renewable energy conference in Nairobi during August, 1981. As follow up action nore emphasis was placed on non-polluting and environmentally renewable energy techno-

logies. The twin objective of energy production and environment preservation are to be largely met by this concept of renewable form of energy resources (Chaturvedi 1991). Creation of apex organisations such as Indian Renewable Energy Development Agency, Commission for Additional Sources of Energy and Department of Non-Conventional Energy Sources is an indication of sincerity on the part of the government to look at policy formulation and programme implementation. Launching of two national projects namely Improved Chullah (Stoves) Programme and Bio-gas Development Programme are indications of attempt towards rationalization of energy programme in backward areas. Efforts to gainfully harness and decentralize energy in remote and hilly areas are taken by State and central agencies. But the benefit from such measures was found to be m inimal in the surveyed area.

Though in the Seventh Five Year Plan Integrated Rural Energy Planning (IREP) programme was developed on a pilot basis in 250 blocks to meet mainly the basic needs of cooking, heating and lighting specially for the weaker sections by utilizing locally available energy resources and claim to have sufficient micro level experience, none of the surveyed villages and poorer households were found to benefit from the extension and demonstration efforts. One has to wait to see whether as desired in the eighth plan this programme takes care ^f minimum energy needs of cooking, heating and lighting so as to ensure 100 per cent coverage for economically weaker section and ensures large scale people's participation.

The social forestry scheme which aims at meeting the fuel, fodder and other domestic needs of the rural population in addition to restoring ecological balance was not paying off for the fuelwood scarcity ridden villages.

A purposeful and worthwhile involvement of the public in decision making is still elusive, despite the constitution of India proclaiming the ultimate goal of public participation at all stages of development. Till date the rural reconstruction in India has mostly been a governmental affair with national, provincial and local agencies conceiving and executing multifarious schemes of development.

Crudely regarded as the index of partaking of the masses in efforts of rural reconstruction, the voluntary organizations are abysmally non existent in the surveyed villages and extremely constricted in their area of operation, if one takes into account fields in which they have engaged themselves. During the field survey the respondents were asked in detail about the visits, if any, by the voluntary organizations from outside or in the village itself, to their households during the six months preceding the survey along with the purpose of visit.

The inferences about community participation as experienced from forty eight villages and eight towns is not encouraging. Only ten villages and five towns in the region of study were descended upon by the voluntary organizations, that too to undertake programmes of limited nature. Cataloguing of the activities undertaken by the NGOs in these area show that the endeavours are narrow in all of their dimensions and the support operations are confined to a few harmonious activities such as provision of basic health check up, women's literacy and vocational education regarding sewing, pottery making etc. In spite of households facing acute shortage of fuels, grossly resorting to inefficient cooking styles and women suffering from fuel related diseases the back-up programmes by government or private sector for

effective tapping of fuels and streamlining of the energy use through impinging upon the cooking system as a whole were found to be lacking. Only four villages that too only in Himachal Pradesh reported about local *Mahila Mandats* (Women's Association) taking interest in fuel crisis occasionally even if almost every respondent was concerned with problems of fuel supply.

Since the demand for household energy in rural areas is chiefly from the umpteen hearths and it is the women who spend a lifetime in cooking it provides a wide scope for involvement of women's voluntary organizations in one of the grey areas of energy consumption. As main gathers and users of forest products, principal tenders of the animals and decision makers in the households, the women are more aware about emerging scarcities and receptive to plantation efforts. Their specialised knowledge and potential contribution must be harnessed by the community projects, both of social forestry and energy management. Since all these programmes are directly beneficial to women, generation of awareness and education of women beneficiaries is best carried out by women themselves (Chaturvedi 1991). For all these, the intervention programmes have to view the innovations from women's perspectives and not from the criterion of technological creativity so that the acceptance of initiatives are long term.

Conclusion

In sum, the households, both rural as well as urban, are essentially dependent on conventional fuels for meeting their energy requirement and the primary source of energy range from firewood to cow dung depending on the overall socio-economic status of the household and surrounding physical environment. If the study area is classified into plain and hilly region, a well established trade-off between these two types— the direction being defined by either access to forest based resources or ownership of cattle—is observed. The settlements located in hills depend more on woodfuel, whereas in prosperous agricultural areas reliance on cow dung is substantial. While proximity to forests is incentive to use of forest based resources as fuel, the ownership of livestock prompts households to opt for cow dung. Excessive usage of either woodfuel or cow dung in domestic cooking has implications not only for women, but for environment also. Since collection and/or preparation of firewood and cow dung as final fuel involves considerable female labour input, the negative consequences for their health can not be ignored. In view of lower female literacy and higher population growth rates already encountered in surveyed villages and towns, the problems compound. The modern fuels which liberate them from part of the cooking drudgery still eludes women in poor households and conventional fuels have acted as drag on female status enhancement.

Since in Indian context caste and class are largely co-terminus, the characterization of socially backward communities by their greater propensity to use inferior type of fuels should not be presumed that cultural rigidity, rather than economic well-being, prevents the spread of modern fuels. In economic front, the Muslim and scheduled caste households in the study area are marked by greater incidence of poverty, low land ownership, poor living conditions

(Nanda 1993). Culturally these minorities are more nucleated and their exposure to outside forces of modernization is least. As a result—the price rise, scarcity, deterioration in quality and lack of technological up-gradation is relatively more burdensome to women in these communities. For example, the scheduled caste women who usually live in nuclear families are finding it increasingly strenuous to go out for fuel collection as there is no other member left in house to look after the children in their absence. Combining motherhood with extra work does seems to have a heavy toll on them.

Making most use of firewood and cow dung for fuel has also environmental consequences both at micro and macro level. In the domestic scene these fuels are harmful to the members of household particularly women who cook and are exposed to the smoke for long hours. Shortage of fuel also means less frequency of heating as well as cooking hot meals and this has health overtones. But the other casualty is rural eco-system which has to bear the brunt of the plight arising out of deterioration in fuel situation, Felling and pruning of trees either in designated forest area or in privately owned land has obvious repercussions on environment. But the exact context and mechanism of environmental destruction resulting from fuel related encroachment needs further probing. Ownership of cattle not only means pressure on environment caused by grazing but also deprivation of soil from compost as dung is used as fuel.

Hence, the fundamental issue to be addressed while investigating the interface among energy, environment and women is the underlying socio-economic setting in which the these households are perforce compelled to derive some of the basic requirements from the natural environment for their survival. Much also depends on the process of economic development, its meaning and nature which has marginalized a bigger segment of the society for the benefit of a few. Poverty has persisted for long and anti poverty measures have not ameliorated their plight. Land reform has not brought relief, changes in agrarian structure circumvented many and social security measures have been scanty and untimely. So deprivation manifests in all dimensions including inefficient fuel use and poor cooking practices. The hardships of living finally trikle down to the women because of their role centrality. Although economic planning is professed to be bottom up in nature, the local activities for survival, specifically reliance on common property resources like forests, suggest there is nothing at grassroots to support landless labourers and small as well as marginal peasantry. Local and indigenous initiatives have been systematically damaged over the years and governmental efforts have lost credibility. All these have led to evolution of indigenous mechanisms where one extracts from surrounding natural resources for survival.

The conflicts over natural resources, especially forest are to be viewed in terms of existing exploitative socio-economic and political structure. The votaries of environment must understand the forces unleashed by economic deprivation, aggravated by liberalization and finally sustained by lack of proficient intervention for the economically weaker sections. The problems being *ad infinitum* in nature, long term solutions are needed. The decline in welfarism has to be reversed, just and humane social order has to be created so that poor do not become environmental scapegoats. For development to be sustainable the questions of hunger, equity and empowerment have to be tackled so that the deprived sections are not

pushed to direct dependence on forests for their survival. All including women then can be real custodians of natural resources.

Acknowledgements

The authors are grateful to Shri Rashpal Malhotra, Director and Prof. B. L. Abbi, Chief Research Adviser, CRRID for their valuable comments and suggestions. However, the authors are solely responsible for errors and ommissions, if any.

Bibliography

Achaya, K. T. and Huria, V. K., 1986, Rural poverty and operation flood. *Economic and Political Weekly*. 21(37).
Aggarwal, Anil and Narain, Sunita, 1985, Women and natural resources. *Social Action*. 35.
Ahmed, Ausuf, 1992, Economic development oflndian Muslims: Issues and problems. *Islam and the Modern Age*. 23(4).
Bose, Ashish, 1994, Household fuel consumption patterns, *Financial Express*. New Delhi, May 5th. Chaturvedi, P., 1991, Renewable source of energy: Role of voluntary agencies, *Yojna35(4)*. Eckholm, E., Foley. G., Barfnard.G. and Timberlake, L., 1984, *Fuehmod: The Energy Crisis that* iron*'t Go Away*. An Earthscan Paperback, International Institute of Environment and Development, London. Gadgil, M. and Guha. R , 1994, Ecological conflicts and environmental movement in India, *Development and Change*. 25(1).
Gaul, Karen, 1994, Exploding myths: Women, men and work in a Himachal village, *Manushi*, 81. Jefferry, R., Jeffery, P. and Lyon, A., 1989, Taking dung-work seriously: Women's work and rural development in north India. *Economic and Political Weekly*. 24 (17).
Planning Commission, 1979. *Report of the Working Group on Energy Policy*. Government of India, New Delhi.
Nanda, A. K., 1993, Socio-economic Condition and Reproductive Behaviour. *In: Peoples Perception and Reproductive Behaviour in North West India*.. Report Submitted to Ministry of Health and Family Welfare, Government of India, New Delhi. Ramakrishnan, R , 1994. Issues in rural energy planning in India, *Yo/na*. ***39*** (5). Ministry of Information and Broadcasting. Government of India, New Delhi.
Reeds, Judith, 1990. *Natural Resources: Allocation. Economics and Policy*. 2ndedn. Routledge. London. Rogers, Barbara. 1983, *The Domestication of Women: Discrimination in Developing Societies*. Tavistock Publications. London. Sehgal, J. L., Mandal. D. K., Mandal. C. and Valivcdu. S.. 1992. *Agro Ecological Regions of India*. Technical Bulletin, NBSS Publication 24. National Bureau of Soil Survey and Land Use Planning, Indian Council of Agricultural Research. Nagpur. Shiva, Vandana, *\W\, Ecology and the Politics of Survival.Conflict Over Natural Resources in India*. United Nations University Press and Sage Publications. New Delhi.
Subramaniam, Mangala. 1994, Designing wood-tired cooking stoves: Where is the woman?. *Economic and Political Weekly*. 29 (20).
Sugumar, V. R., 1990, Smoke exposure and health hazards. *Yojana*. 34(3). Tirumalesh, K. V.. 1990. *In:* S. Tharu and K. Lalila (eds.). *Women Writings in India: 600 B.C. to the Present*. Vol. I. Oxford University Press. New Delhi. Demography Division. Office of Registrar General and Census Commissioner, *Housing and Amenities*. Census of India 1991. Paper 2 of 1993. Series I. India.